EFFECT OF KNOXWEED ON THE CONTROL OF WEEDS IN PADDY RICE

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Knoxweed, a new herbicide of Eptam+MCPA mixture produced by the Stauffer Chemical Company has been under testing for its effect on weed control in transplanted rice in Taiwan since 1967. Exprimental results so far available indicated that weed control effect of this chemical was rather variable. Tang and Tsai (1967) reported that Eptam + MCPA gave good control of both grass and broad-leaved weeds, but experiments conducted at Hsinchu and Taichung showed a poor control of weeds in transplanted rice (PDAF, 1967). Additional testing on this chemical is, therefore, necessary. The purpose of this experiment was to compare several combinations of Eptam+MCPA on the control of weeds in the first crop of rice.

MATERIALS AND METHODS

The experiment was conducted in the first crop (dry season) of 1968 at Tai-tou-ken Farm of the Chiayi Agricultural Experiment Station. Soil of the experimental plots was silty clay loam and pH, organic matter, available P_2O_5 and K_2O of the surface soil were 5.8, 1.80%, 229 kg, and 98 kg per ha, respectively. A *Japonica* rice variety, Chianung 242 was subjected to 12 treatments as listed in Table 1.

Table 1. The application rates, formulation, and time of application of various treatments.

Treatment	Active rate (kg/ha)	Formulation	Time of application
1. Knoxweed (Eptam+MCPA)	2.00+0.8	4.0%+1.6%G	6 days after transplanting
2. Knoxweed (Eptam+MCPA)	2.00+0.6	4.0%+1.2%G	6 days after transplanting
3. Knoxweed (Eptam+MCPA)	2.00+0.4	4.0%+0.8%G	6 days after transplanting
4. Knoxweed (Eptam+MCPA)	1.75+0.8	3.5%+1.6%G	6 days after transplanting
5. Knoxweed (Eptam+MCPA)	1.75+0.6	3.5%+1.2%G	6 days after transplanting
6. Knoxweed (Eptam+MCPA)	1.75+0.4	3.5%+0.8%G	6 days after transplanting
7. Knoxweed (Eptam+MCPA)	1.50+0.8	3.0%+1.6%G	6 days after transplanting
8. Knoxweed (Eptam+MCPA)	1.50+0.6	3.0%+1.2%G	6 days after transplanting
9. Knoxweed (Eptam+MCPA)	1.50+0.4	3.0%+0.8%G	6 days after transplanting
10. Unweeded Check	—	—	—
11. Hand weeded Check	—	—	3 times
12. TOK (Check)	2.0	7%G	6 days after transplating

* The writer wishes to thank Professor Stassen Y. G. Soong, Far East Representative of the Stauffer Chemical Company, for his kind help during the course of this experiment.

The design of the experiment was a randomized complete block with 3 replications. The plot was 2.5 x 6.0 m in size from which 1.0 x 4.0 m or 4 m^2 was harvested for yield determination. The plant spacing was 25 x 20 cm with approximately 5 seedlings being transplanted at each hill. Ammonium sulphate, calcium superphosphate, and potassium sulphate was used as carriers of N, P_2O_5, and K_2O which were applied at the rate of 100, 50, and 50 kg per ha, respectively. Herbicides were applied to a shallow (2-3 cm) flood of water by broadcasting and the same level of water was maintained for about 10 days after the application of herbicides.

Weed control was recorded in percentage at 2, 4, and 8 weeks after application of herbicides. Phytotoxicity to rice was also recorded in percentage once a week started from one week after herbicide application. Dwarf and wilted rice plants were also counted. Dry weed weight per plot was taken at the time of harvesting.

The weather in the early stage of rice growth was cold, dry, and sunny, but hot and rainy weather prevailed during the late growing stage. The climatic data of the whole rice growth are presented in Table 2.

Table 2. Climatic data of the Chiayi Agricultural Experiment Station during the period of the experiment.

Ten-day Period	Rainfall amount (mm)	Number of rainy days	Number of sunshine hours	Relative humidity (%)	Temperature (°C)		
					Maximum	Minimum	Mean
March 1—10	0	0	64.4	64	22.3	12.4	17.4
11—20	0	0	42.0	64	26.4	17.1	21.7
21—31	178.4	9	9.8	79	24.4	17.3	20.9
April 1—10	1.9	2	32.1	73	26.4	19.3	22.9
11—10	0.9	2	15.8	74	26.9	19.2	23.1
21—30	16.8	2	40.7	67	25.8	15.9	20.9
May 1—10	0	0	29.7	63	29.9	20.9	25.4
11—20	0	0	25.6	60	31.2	22.9	27.0
21—31	245.4	9	3.3	82	29.3	24.0	26.7
June 1—10	125.2	7	41.5	77	30.0	22.5	26.3
11—20	314.6	5	13.5	68	31.2	23.5	27.4
21—30	149.4	6	45.3	65	31.3	24.3	27.7
July 1—10	141.1	5	47.9	66	32.0	25.4	28.7

RESULTS AND DISCUSSION

Weed Control Effect

The number of weeds counted at the time of herbicides application revealed that the infestation of weeds in the experimental plots at the early stage of rice growth was mostly the broad-leaved weeds (Table 3). The most common broad-leaved weeds in the plots were

Monochoria vaginalis, *Dopatrium junceum*, *Marsilea quadrifolia*, *Lindernia pyxidaria*, and *Eclipta prostrata*. The grasses were predominately *Echinochloa crusgalli* and *Paspalum scrobiculatum*, whereas *Cyperus difformis*, and *Cyperus iria* were the predominant sedges.

The number of weeds counted at 2, 4, and 8 weeks after the application of herbicides indicated that various Eptam + MCPA combinations gave good control of weeds, including grasses, broadleaves, and sedges. The results were similar to those reported by Tang and Tsai (1967). When expressed by the percentage of weed control of the plot, Eptam+MCPA combinations gave more than 90% weed control at 2 and 4 weeks after the application of herbicide and more than 70% weed control at 8 weeks after the application of herbicide which were higher than those of hand weeded check and TOK (Table 4). Both weed counting and percentage of weed control indicated that weed control effects of various Eptam+ MCPA combinations could last for one to two months. Since weed competition with rice was reported to be most serious during the first 30 days after the emergence of weeds (Shaw and Danielson, 1961), Eptam+ MCPA appears capable of preventing weed injury during the most critical period of rice growth. The weed control effects of various Eptam+ MCPA combinations varied slightly suggesting that good control of weeds may be obtained with the lowest rates of Eptam and MCPA (1.50 and 0.4 kg per ha, respectively) and it seems economically unfeasible to apply Eptam and MCPA higher than these rates.

Dry weight of weeds taken at the time of harvesting is also presented in Table 4. Although dry weight of weeds showed poor agreement with weed control effect, treatments with good weed control were found to be generally associated with low dry weed weight.

Table 3. Number of weeds per m^2 counted at different times.

Treatment	At the time of herbicide application				2 weeks after herbicide application			
	Grasses	Broad leaves	Sedges	Total	Grasses	Broad leaves	Sedges	Total
1	16	64	27	107	0	0	0	0
2	11	37	32	80	0	37	0	37
3	11	91	53	155	0	0	0	0
4	5	128	91	224	0	5	0	5
5	0	75	53	128	0	48	0	48
6	0	75	64	139	0	16	0	16
7	0	171	64	235	0	0	0	0
8	5	101	128	234	0	64	0	64
9	0	91	48	139	0	0	0	0
10	5	117	27	149	11	283	0	294
11	0	101	133	234	0	11	0	11
12	0	53	69	122	0	11	32	43
Mean	4	92	66	162	1	40	3	43

Table 3. Number of weeds per m² counted at different times. (countinued)

Treatment	4 weeks after herbicide application				8 weeks after herbicide application			
	Grasses	Broad leaves	Sedges	Total	Grasses	Broad leaves	Sedges	Total
1	0	0	0	0	0	336	21	357
2	0	11	37	48	0	267	69	336
3	0	43	11	54	0	363	43	406
4	0	48	0	48	0	485	59	544
5	0	32	0	32	0	309	37	346
6	0	32	11	43	0	389	22	421
7	0	107	0	107	0	523	16	539
8	0	32	11	43	0	411	27	438
9	0	11	0	11	0	219	21	240
10	13	256	11	280	16	731	5	752
11	0	64	0	64	0	165	0	165
12	0	37	43	80	16	368	48	432
Mean	1	56	10	67	3	381	31	415

Table 4. Percentage of weed control and dry weed weight at the time of harvesting.

Treatment	Weed control (%)			Dry weed weight (g/m²)			
	2 weeks	4 weeks	8 weeks	Grasses	Broad leaves	Sedges	Total
1	94	97	73	0	56.0	20.8	76.8
2	92	91	72	116.8	30.4	211.2	358.4
3	92	94	77	0	91.2	8.0	99.2
4	87	95	68	22.4	59.2	86.4	168.0
5	89	88	78	28.8	64.0	40.0	132.8
6	87	92	74	97.6	72.0	8.0	177.6
7	97	92	74	168.0	46.4	80.0	294.4
8	97	95	78	267.2	57.6	68.8	393.6
9	94	93	78	0	46.4	84.8	131.2
10	0	0	0	89.6	73.6	78.4	241.6
11	42	77	65	0	16.0	0	16.0
12	37	43	32	30.4	30.4	238.4	299.2

Phytotoxicity to Rice

The percentage of rice toxicity, rice plants showing dwarf symptom or completely killed, are presented in Table 5. Rice pants began to show phytotoxicity symptoms one week

Table 5. Phytotoxicity of herbicides to rice.

Treatment	Phytotoxicity percentage (%)				Dwarf plants (hill)			Plants killed (hill)		
	Weeks after herbicide application				Weeks after herbicide application			Weeks after herbicide application		
	1	2	6	8	2	6	8	2	6	8
1	37	32	35	27	49	23	14	1	5	6
2	17	18	18	10	36	10	8	1	4	4
3	17	17	13	5	42	12	9	0	2	2
4	32	25	33	17	36	18	9	2	4	4
5	25	20	23	8	31	10	8	1	1	2
6	13	17	7	2	13	12	6	0	0	0
7	37	33	33	13	51	18	7	2	5	5
8	35	43	42	27	81	27	12	2	6	6
9	10	13	12	3	23	9	8	1	2	2
10	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0

after the application of Eptam+ MCPA. At first, the phytotoxicity was manifested mostly by chlorosis, stunting, and dwarf seedlings, but with the progress of time, the most seriously affected plants stopped to grow and eventually killed. Although the degree of Phytotxicity gradually decreased with the growth of rice plant, rice toxicity was still evident even at 8 weeks after herbicide application. The phytotoxicity of Eptam+ MCPA was also observed by Tang and Tsai (1967) and other stations (PDAF, 1967).

It was of interest to note that that the phytotoxicity of Eptam + MCPA to rice increased with rates of MCPA but varied slightly with rates of Eptam, indicating that MCPA seems to be the component responsible for the high toxicity of the herbicide, knoxweed. It appears, therefore, that the rate of MCPA should be reduced to the mimimum necessary for good control of weeds, if the phytotoxicity of knoxweed to rice is to be improved. Tang and Tsai (1967) suggested the that active rate of MCPA should not exceed 0.2 kg per ha. It was also found that MCPA applied at 15 days after transplanting caused no toxicity to rice (Chang 1968). Thus, it seems highly likely that phytotoxicity of Eptam +MCPA can be reduced if it is applied at 2 weeks instead of at one week after the transplanting. No phytotoxicity to rice was detected for TOK treatment.

Rice Growth and Grain Yield

Plant height was shorter and average number of tillers per hill was smaller in Eptam

+ MCPA treatments when compared with those of hand weeded check at 50 days after transplanting, showing that Eptam + MCPA inhibited the growth of rice at the the early stage (Table 6).

Table. 6 Effect of knoxweed on the growth and grain yield of rice.

Treatment	At 50 days after transplanting		At maturity stage		Heading date (days)	Grain yield	
	Plant height (cm)	Number of tillers per hill	Plant height (cm)	Number of panicles per hill		(kg/ha)	(%)
1	67.9	13.6	111.7	11.4	87	3,980	70.7
2	69.8	13.8	111.8	10.4	86	4,604	81.8
3	71.6	14.7	113.2	11.1	86	4,760	84.6
4	67.3	13.6	114.8	11.1	87	4,560	81.1
5	69.8	14.7	111.9	10.6	85	4,584	81.5
6	70.2	13.7	108.5	10.5	84	4,554	81.0
7	68.9	12.4	113.4	10.4	87	4,546	80.8
8	67.7	12.7	113.0	10.7	87	4,620	82.1
9	69.6	12.5	112.1	10.0	85	4,946	87.9
10	71.2	13.8	110.3	9.7	83	4,580	81.5
11	71.4	15.0	114.6	11.0	83	5,626	100.0
12	71.3	14.2	111.0	9.6	83	4,666	82.9
Mean	69.7	13.7	112.2	10.5	85	4,669	83.0

However, the growth of rice plants recovered gradually and practically no differences in plant height and number of panicles per hill were observed between Eptam + MCPA and hand weeded treatments at maturity stage. The heading date of rice plants was delayed considerably by the application of Eptam + MCPA. It was found that treatments with severe phytotoxicity of rice generally headed late, indicating that slow recovery from the chemical injury was the major factor responsible for delayed heading of rice.

Hand weeded check produced the highest yield whereas Treatment 1 with highest rate of Eptam + MCPA gave the lowest yield which was 29.3% less than that of the hand weeded check (Table 6.) Grain yields of most of the Eptam + MCPA treatments were similar to that of unweeded check which was 18.5% lower than that of the hand weeded treatment. The low yield of Eptam + MCPA treatments may be attributable to their severe phytotoxicity to rice whereas that of unweeded check, to weed competition.

It was found that applications of Eptam 2 kg + MCPA 0.4 kg per ha (Treatment 3) and Eptam 1.5 kg + MCPA 0.4 kg per ha (Treatment 9) outyielded the recommended chemical, TOK (Treatment 12) by 2.1 % and 6.2%, respectively. The higher grain yield production of these treatments may be due largely to their better control of weeds than that of TOK. If the phytotoxicity of Eptam + MCPA can be improved by reducing the rate of MCPA or adjusting the time of application, it appears highly probable that this chemical

may become a good herbicide for paddy rice.

SUMMARY

Several combinations of Knoxweed (Eptam + MCPA) were evaluated for their weed control effect at the Chiayi Agricultural Experiment Station in the first crop of 1963. All treatments of Eptam + MCPA were found to be highly effective in controlling weeds in paddy rice and its effect was found to last more than 8 weeks after the application of this chemical. However, Eptam+ MCPA caused severe phytotoxicity to rice. Rice toxicity was found to be related to the rate of MCPA, the higher the MCPA rate, the heavier the rice toxicity. As a result, grain yields of all Eptam + MCPA treatments were 12.1 to 29.3% lower than that of hand weeded check.

LITERATURE CITED

1. Chang, W.L. 1968. Weed control effect of some herbicides in paddy field. Jour. Taiwan Agr. Res. 17(2):15-25.
2. Provincial Department of Agriculture and Forestry, Taiwan Provincial Government. 1967. Annual Report of Plant Protection. pp. 243-280.
3. Shaw. W.C. and L. L. Danielson, 1961. The control of weeds in seed crops. The year book of Agriculture, pp. 280-287.
4. Tang, W. T. and W. F. Tsai 1967 Testing of some herbicides in paddy field. Sci Agr. 15(11, 12): 341-344.

水田殺草劑 Knoxweed 之治草效果

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摘 要

有效成份含量不同之 Knoxweed 若干種經本分所於57年第一期作水稻田試驗結果，發現不同成分之處理均具優良之治草效果，但因對水稻之藥害極爲嚴重，其每公頃稻谷產量僅達人工除草區之71～88%。